

APPLICATION OF FEDERAL ADP CODE AND MEDIA STANDARDS

1. Introduction

Public Law 89-306 authorized the Secretary of Commerce to make appropriate recommendations to the President relating to the establishment of uniform Federal automatic data processing standards. The President, on March 11, 1968, approved as Federal standards the USA Standard Code for Information Interchange (ASCII), as well as standards implementing the Standard Code in perforated tape and magnetic tape media (see Attachments 1 and 2). The announcement also delegated the responsibility of providing details on these standards and their application to the Secretary of Commerce. A glossary of the specialized terms employed in this paper is included as Attachment 3.

2. Purpose

The purpose of this memorandum is to identify the objectives of these standards and relate the specific standards to these objectives, and to provide instructions for application.

3. Objectives

The objectives of Public Law 89-306 are to provide for the economical and efficient purchase, lease, maintenance, operation and utilization of automatic data processing equipment by Federal departments and agencies. The development, adoption and implementation of appropriate information processing systems standards will contribute to the objectives of P.L. 89-306 by providing such benefits as:

- a. Improved cost effectiveness in the procurement and continued use of information processing systems and equipment, including supporting software.
- b. Extension of the economic benefits of data processing and computing through increased compatibility between and within systems, sharing of facilities among users, and simplified methods and procedures for the use of information processing facilities.
- c. Increased freedom of selection of equipment which conforms to compatibility standards, and hence increased competition among suppliers of information processing equipment and supporting services.
- d. Greater flexibility in the use of programs and data in computers provided by all suppliers, facilitated by appropriate standards for compilers and validation techniques.

One of the vital elements in realizing these objectives is the provision of the highest practical level of compatibility for the interchange of information in machine-processible form within and between information systems, including input/output equipment, source data automation equipment, other associated equipment, and communication systems. This includes the maximum use of standard programming languages and recording techniques so as to minimize the need for reprocessing, reordering, or converting of information in information processing operations.

A standard coded character set, standards which prescribe the method of representing the coded character set in media used for input/output purposes, and a standard collating sequence, are also basic requirements for compatible interchange of data in automatic data processing operations. It is becoming increasingly difficult to distinguish between data which will always remain inside the originating installations and that which may now or later be needed elsewhere. Moreover, an installation under one manager's control and performing only the tasks of a single organizational unit now is frequently spread over multiple locations, or may have many remote terminals. In such a situation the distinction between internal and external information flows almost disappears. Use of the same character set, code, media and collating sequence for installation files eliminates the need for such distinctions and hence will facilitate interchange.

It is the intention of the Federal ADP Standards program that all installations adopt the ASCII code, media and sequence standards and that progress be made toward this objective in as rapid a manner as is economically and technically feasible.

These Federal ADP standards do not extend to the internal structure of the central processing unit or peripheral devices. In general, therefore, computers may operate in any mode and use any internal code which the equipment manufacturer deems most efficient.

4. Scope of Application

The President's memorandum of March 11, 1968, and these instructions, apply to computers and related equipment configurations brought into the Federal inventory or acquired or leased with Federal funds as set forth in Paragraph 3, BOB Circular A-54 Revised June 27, 1967. They also apply to data systems developed for implementation by or for Government agencies, and to data developed outside the Federal Government at Government expense if such data is to be a part of the data base of a Federal agency. Related equipment includes all character-oriented equipment in which magnetic tape or perforated tape is produced for input to a computer based data system or received as output from a computer based data system. These instructions also apply when transmission terminal equipment and facilities are procured primarily in support of a computer based data system.

The President's memorandum applies to new or used equipment brought into the inventory from outside. Complete systems and systems components can also be transferred between agencies, or between installations within an agency. The General Services Administration facilitates such transfers by availability notices. Whenever equipment is available through these avenues which conforms to or can be adapted to the standards, it will be given preference over equipment which does not conform and cannot be adapted.

Central processor, peripheral or other related equipment used substantially full time as part of the control element in a larger system, where that larger system (weapons control, for instance, or a manufacturing process) is not itself primarily concerned with information activities, is not within the scope of application of these Federal standards. However, since general purpose equipment used in these systems may be used elsewhere at a later date, agencies should conform to the ASCII standards wherever possible.

5. Instructions for Implementing the Standards

Most of the computers and related equipment currently in use by the Federal Government are of a generation which pre-dated the approved Federal ADP standards. In view of the Government's investment in this equipment, the transition to these standards will be made on an evolutionary basis as equipment is replaced or added, computers are reprogrammed and data systems are redesigned. It is not the intention at this time to require the immediate conversion of

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existing data systems and equipment for the sole purpose of conforming to Federal ADP standards. Utilization of existing non-standard systems and equipments should be continued as long as economically advantageous.

On the other hand, when a system conversion of any magnitude is planned (new or more powerful hardware, machine-independent software or, especially, remote-access operation), an agency must not only conform to the Presidential order by acquiring the prescribed hardware or software capability, but must include in its plans the actual introduction of ASCII character set, code, media and sequence standards as soon as consideration of economics and personnel permit. While techniques for interchange shall be given priority, introduction of the standards for character coded data and program storage within installations and conversion of appropriate existing files shall also proceed as rapidly as possible.

Specifically, when interchange and internal file techniques are updated from Hollerith, binary-coded decimal, pure binary and six-bit-oriented codes and media, the ASCII character, code, media and sequence standards shall be applied. In no case may a non-standard alternative be introduced.

More efficient utilization of magnetic tape and other media for interchange and for installation files is sometimes realized by the use of non-standard techniques (packed numerics, floating point, pure binary). Where such techniques have already been adopted, local use may

be continued until Federal standards applicable to these techniques are promulgated. To facilitate United States of America Standards Institute (USASI) and Federal standards development, agencies making heavy use of such techniques should advise the National Bureau of Standards of the form, degree and length of use, application, and technical or cost advantages of the representations used. If the use of these techniques established prior to the issuance of applicable Federal standards is to carry past a replacement or augmentation procurement, the waiver procedure (see Section 9) must be followed.

The memorandum of March 11 requires that all computers and related equipment configurations brought into the Federal Government inventory on and after July 1, 1969, must have the capability to use ASCII and the formats prescribed by the magnetic tape and paper tape standards when these media are used. The following instructions apply:

- a. New Installations. The standard code and the magnetic tape and paper tape standards shall be implemented in new additions to the inventory, and their use must be specified in requests for proposals in all cases where there are no significant existing tape files or program libraries which prevent their immediate use. The supporting software shall be compatible with the character set, code, media and collating sequence of the approved Federal standards.

b. Replacement of Computers and Related Equipment.

Introduction of replacement computers often involves reprogramming and file conversion. Such reprogramming and file conversion may be completed when the replacement becomes operational, particularly if the data system has undergone major revision. In this case, the standards and supporting software shall be fully applied upon conversion. If the reprogramming and file conversion is to be completed over a prescribed time period, the standards shall be phased in as the reprogramming and conversion is accomplished.

Replacement equipment added to the inventory which does not require significant reprogramming effort must immediately utilize the approved standards wherever technically possible and economically feasible.

c. Augmentation of an Existing Computer Configuration.

It is sometimes necessary to augment an existing computer installation with additional computer, peripheral or related equipment which must make use of the same media files as the older equipment. In this case, use of the standards may have to be deferred until segments, subsystems or the entire system can be converted to the standards. Added equipment should if possible have ASCII capability; if not, the waiver procedure (see Section 9) must be invoked.

New capabilities added to an existing installation or system, such as remote terminals or a source data acquisition subsystem, should make use of the approved standards wherever technically possible and economically feasible. If the full character set of ASCII cannot be applied, the largest possible character subset (see Section 8) should be used, and the ASCII collating sequence observed.

6. Interchange Between Installations

One of the benefits to be derived from character set, code, collating sequence and input/output media standardization is improved ability to exchange data between installations of computers and related equipment. The full benefits of standardization will be realized as input/output equipment which uses the standards replaces the present inventory. The ASCII character set and implementing input/output media standards shall be used whenever data is interchanged between two installations which have equipment conforming to the standard. The standards also can be used effectively for interchange between installations even though some of the installations involved do not yet use the standard media within their data processing operations.

Agencies which already receive large quantities of machine-readable submissions from other Government sources or from outside organizations are often required, usually empowered, and almost always expected, to specify acceptable media, codes and formats. For this reason, and

because the Federal ASCII standards are in exact accord with the USASI national character, code, media and sequence standards, such agencies should take the lead in utilizing ASCII techniques themselves, and are encouraged to require it of their sources at the earliest practical date.

7. ADP - Telecommunications Interface

ASCII is also a standard for telecommunication networks. Some Federal telecommunications systems operate in ASCII; others will when updated in conformance with the plan for the National Communications System (administered by the Office of Telecommunications Management in the Executive Office of the President). Therefore, users of all computer systems and components which will use Federal communications systems for the transmission of data shall consult with the Office of Telecommunications Management as to interface requirements.

8. Character Sets

ASCII defines a set of 128 characters commonly used in information processing and communications. Ninety-four characters of the set are graphic symbols (upper and lower case alphabet, decimal digits, punctuation and special symbols); thirty-two are used for control functions; the remaining two are "space" and "delete." This set of 128 characters, when coded in binary format, requires a minimum of seven bits for a unique representation of each character. Representation of this binary code on standard-conforming paper tape is by seven bits. Representation on standard-conforming magnetic tape is by eight bits. The magnetic

tape standard specifies that the eighth bit will be recorded as "zero." The recording of "one" in the eighth channel will be governed by the procedures for expanded sets specified in paragraph d. below. Many computing, data processing, and communications applications require only a limited character set. Other applications may require a character set of about the ASCII size, but with very different graphics (Cyrillic alphabet, mathematical symbols). Still others may require a very much larger set (general library applications, cartography, typesetting).

Permitted character sets are as follows:

- a. Basic or standard set. Use of ASCII as promulgated and officially maintained by USASI, and as registered in the National Bureau of Standards Federal Information Processing Standards Register (FIPS Register). This should be used wherever the capability exists and wherever additional graphic or control characters are not absolutely necessary.
- b. Subsets. Use of a smaller number of ASCII characters, the individual character code assignments remaining unchanged. Examples are a 16-character "numeric" subset and various high speed printer subsets. Use of one or more of these ASCII subsets is a powerful tool in bridging the conversion gap prior to the procurement or utilization of hardware with full ASCII capability.

- c. Extended sets. Use of alternate assignments of the 128 binary patterns. This may be accomplished by use of the ASCII control characters SO (Shift Out), SI (Shift In) and ESC (Escape). Such use may be planned by agencies having special requirements, but must not be finalized until approved by NBS and entered in the FIPS Register. Once an extended set has been identified and approved and entered in the FIPS Register it may be used for applications and by installations other than the original without specific approval by NBS.

- d. Expanded sets. Use of the complete 256 eight-bit character codes made possible by the availability of eight information channels on standard magnetic tape and other media with a capacity for eight data bits. The character set of the expanded code must include the character set of the original code. Use of expanded sets must be approved by NBS and entered in the FIPS Register as described above for extended sets. Once an expanded set has been identified and approved and entered in the FIPS Register it may be used for applications and by installations other than the original without specific approval by NBS.

The approval and registration of extended and expanded sets will prevent uncontrolled character code assignments from leading to incompatibilities like those which preceded

the adoption of ASCII. The register of approved code assignments will be of great value in developing future national and Federal code standards.

9. Waivers

In Section 3, the objectives of the Federal ADP standards program are enumerated. Section 5 provides instructions for furthering these objectives through implementation of the ASCII standards, and recognizes current situations from which evolutionary progress toward the objectives will be achieved. If instances arise in which an agency cannot comply with the provisions of Section 5, the head of the agency is authorized to waive application of these instructions. Generally, two conditions apply in those exceptional cases which would warrant waivers:

- a. Significant, continuing cost or efficiency disadvantages will be encountered by the use of ASCII and,
- b. The interchange of information with other systems is minimal and is expected to remain minimal.

All waivers and the reasons therefore will be coordinated with the National Bureau of Standards sufficiently in advance of final agency authorization that NBS may consider the impact of the decision on the Federal standards program, and the significance of the action with respect to future national standards participation.

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A waiver will not be required for equipment delivered before July 1, 1969, nor for equipment ordered before March 11, 1968 for delivery on or after July 1, 1969. Equipment ordered after the issuance of the Presidential order and before the issuance of this memorandum, for delivery on or after July 1, 1969, and not conforming to the Federal standards, shall be described in memorandum form to the National Bureau of Standards within sixty days of issuance of this letter. In exceptional cases, such as an important and entirely new installation, NBS may request initiation of the full waiver procedure by the agency head.

10. Additional Information

Questions related to these standards or their application as well as comments or recommendations for revisions of these standards should be directed to the Center for Computer Sciences and Technology, National Bureau of Standards, Washington, D. C. 20234.

Attachment 1:
Approved Federal ADP Standards

Attachment 2:
Additional ADP Standards Under Development

Attachment 3:
Glossary of Terms